# Assessing pH and EC compatibility and dry shoot biomass of different waste streams for potting media with the Australian Standard for Potting mixes AS-3743-2003

Report 20/06/2024

RICHGRO
Bring your garden to life

UWA
PERTH · AUSTRALIA

Kayla Dermawan

# Assessing pH and EC compatibility and dry shoot biomass of different waste streams for potting media with the Australian Standard for Potting mixes AS-3743-2003

Project team: Tim Richards[1], Troy Franks[1] (Industry guidance), Bede Mickan[1,2,3] (Research manager), Evonne Walker[2] (Technician), Kayla Dermawan (Work Integrated Learning Student placement).

[1] Richgro Garden Products, 203 Acourt Rd, Jandakot, Western Australia, 6164, Australia

[2] UWA School of Agriculture and Environment, The University of Western Australia, Perth, WA, 6009, Australia

[3] The UWA Institute of Agriculture, The University of Western Australia, Perth, WA, 6009, Australia

## CONTENTS

## BACKGROUND

Potting media products have been an essential component in container gardening, home gardening, and indoor plant cultivation. There are two key constituents that serve important functions: nutrient bases and carbon bases. Nutrient bases provide the necessary nutrients and support for plant growth, and they improve soil fertility by facilitating microbial activity. Meanwhile, carbon bases contribute to the maintenance of soil structure through aggregation, water retention, and prevention of compaction (UConn Home and Education Center, 2016).

Richgro is an Australian-owned company that specializes in gardening and horticultural products, including bagged potting mixes (Richgro, 2023). Over time, issues regarding the depletion of natural resources and the environment have become increasingly prevalent. Due to this pressing matter, Richgro, in an industry partnership with the School of Agriculture and Environment in The University of Western Australia (UWA), decided to assess whether alternative waste streams could provide new, sustainable substitutes for potting media. These alternatives include considering different carbon bases such as Carbon1 and Carbon2. Moreover, they were also looking to explore the potential differences in pH and electrical conductivity (EC) readings when using different size fractions within the waste derived compost material that pose as a nutrient base: Comp1 and Comp2.

Therefore, this research project focused on comparing different combinations of nutrient bases (Comp1 and Comp2), with carbon bases (Carbon1 and Carbon2) in varying ratios. Simultaneously, a commercial comparison of market-ready potting media was conducted to observe the performance of Richgro's Black Marvel and premium mixes.

It is important to note that all substitutes are not yet approved by the Australian Standard AS-3743-2003 for bagged retail potting mix. According to the standard protocol, there are strict guidelines to follow for the EC and pH values of potting mixes on the Australian market. Potting mixes are considered

compatible with the standard if their EC levels are below 2.2 dS/m, and their pH falls within the range of 5.3 to 6.5.

In addition to laboratory testing, a glasshouse experiment was completed at the plant growth facilities of UWA to investigate the plant growth performance of Petunia flowers grown in different ratios of compost fraction and carbon base. The effectiveness of each plant growth was indicated by the dry shoot biomass (g).

Quotes:
University of Connecticut
https://homegarden.cahnr.uconn.edu/factsheets/potting-media/

Richgro https://www.richgro.com.au/about-us/

## PROJECT OBJECTIVES

1. To determine the EC of the different nutrient base fractions and carbon base mixtures (Comp1 vs. Comp2 combined with either Carbon1 or Carbon2).

2. To determine the pH levels of the different nutrient base fractions and carbon base mixtures (Comp1 vs. Comp2 combined with either Carbon1 or Carbon2).

3. To evaluate whether any of the experimental treatments can obtain a ratio that has higher Comp1 content over carbon bases while the EC and pH values are still in compliance with the Australian Standard for Potting mixes AS-3743-2003.

4. To see if any of the trial treatments can be up to par with the market-ready commercialized potting mixes or generate better results from them.

5. To conclude which treatment performed the best in plant growth based on the recorded dry shoot biomass.

## ABBREVIATIONS

Electrical Conductivity (EC) – measure of the ability of the material to conduct an electrical current (also a proxy for salt content/salinity).

Compost blend 1 (Comp1) – This compost is a proprietary product of Richgro

Compost blend 2 (Comp2) – This compost is a proprietary product of Richgro

Carbon blend 1 (Carbon1) – This carbon base is derived from an existing waste source

Carbon blend 2 (Carbon2) – This carbon base is derived from an existing waste source

## EXECUTIVE SUMMARY

1. EC and pH comparison of the different nutrient and carbon bases
    a. EC levels were observed to be significantly higher as the nutrient base ratios increase. This trend is consistent in both Carbon1 and Carbon2 mixtures.
    b. pH levels returned generally higher values when the nutrient base is combined with Carbon2, in which all have exceeded the standard (all Comp1 and Comp2 mixtures with Carbon2 have pH levels higher than 6.5).
    c. The 25/75 and 0/100 ratios for Comp1 and Comp2 in combination with both carbon bases have passed the Australian standard for EC values.
    d. The 0/100 ratio for Comp1 and Comp2 in combination with Carbon1 have passed the Australian standard for pH values.
2. Commercial Comparisons
    a. Seasol Garden Soil Mix showed exceedingly higher EC values than the other retail bagged potting mixes and was the only one to not pass the standard guidelines for EC.
    b. Richgro Black Marvel, Richgro Pro Mix Seaweed, and Garden Basics Premium were the only bagged potting mixes that passed the standard guidelines for pH.
3. EC and pH compliance of trials to the AUS-3743-2003 Standard
    a. Half of the treatments showed EC compliance to the standard
    b. But pH is too high overall to meet the standard guidelines
    c. Only one treatment passed the standard in both EC and pH
4. Dry Shoot Biomass comparison of the different nutrient and carbon bases
    a. The 25/75 ratio for Comp1 with Carbon2 had the lowest dry shoot biomass on average (0.99 g).
    b. The top three best-performing treatments on plant growth include the 100/0 ratio for Comp2, 75/25 ratio for Comp2 with Carbon1, and 75/25 ratio for Comp1 with Carbon2.

Across all the experimental treatments performed in this investigation, the 100% Carbon1 treatment performed the best. The treatment show compliance to the pH and EC levels in the AUS Standard.

## EXPERIMENTAL DRAFT

In this experiment different fractions of a waste derived compost material ("nutrient bases") (Comp1 and Comp2) were combined with different "carbon bases" (Carbon1 and Carbon2). The mixtures differ in ratios from 100% nutrient base - 0% carbon base to 0% nutrient base - 100% carbon base in 25% percent intervals.

In total, the experiment consists of 16 treatments with three reps each. The exact composition of the different treatments can be found in the table on the following page.

*Table 1. Experimental design of different fractions of Comp1 nutrient input to different carbon base ratios. Each treatment was replicated three times.*

| Treatment | Comp1 % | Carbon1 % |
|---|---|---|
| 1 | 100 | 0 |
| 2 | 75 | 25 |
| 3 | 50 | 50 |
| 4 | 25 | 75 |
| 5 | 0 | 100 |
| | Comp1 % | Carbon2 % |
| 6 | 75 | 25 |
| 7 | 50 | 50 |
| 8 | 25 | 75 |
| 9 | 0 | 100 |
| | Comp2 % | Carbon1 % |
| 10 | 100 | 0 |
| 11 | 75 | 25 |
| 12 | 50 | 50 |
| 13 | 25 | 75 |
| | Comp2 % | Carbon2 % |
| 14 | 75 | 25 |
| 15 | 50 | 50 |
| 16 | 25 | 75 |

# MATERIALS AND METHODS

## PH AND EC ANALYSIS

1) Both the Comp1 and Comp2 products were manufactured and sieved at the Richgro facilities.
2) Both the Carbon1 and Carbon2 products were derived from the Richgro facilities.
3) After acquiring all materials, the treatments have been mixed in 20L bag sizes with ratios in accordance with the table on the previous page.
4) For pH and EC testing, samples of 200ml size were premoistened eight days before testing and stored in a safe environment to prevent drying out.
5) All pH and EC analysis on organic substrates were performed at the University of Western Australia soil sciences laboratories, following Appendixes D and G of the Australian Standard 3743-2003 procedures. All samples were analysed in triplicate and presented as the mean with the standard error of the mean in error bars.

## GLASSHOUSE EXPERIMENT (POTTING TRIALS)

1) For potting, 234 petunia flowers were planted across 78 pots with three punnets submerged in each pot.
2) The pots were stored in a glasshouse on the UWA campus (Plant Growth Facility) and irrigated twice a day for five minutes via irrigation tubes inserted into each pot.
3) The petunias were monitored several times a week for six weeks.
4) When ready for harvesting, the petunias were cut from the stem base, placed in labelled paper bags, and stored in an oven for drying.
5) The dried plant materials were then weighed for dry shoot biomass measurements.

# RESULTS

## PH AND EC COMPARISON OF NUTRIENT AND CARBON BASES

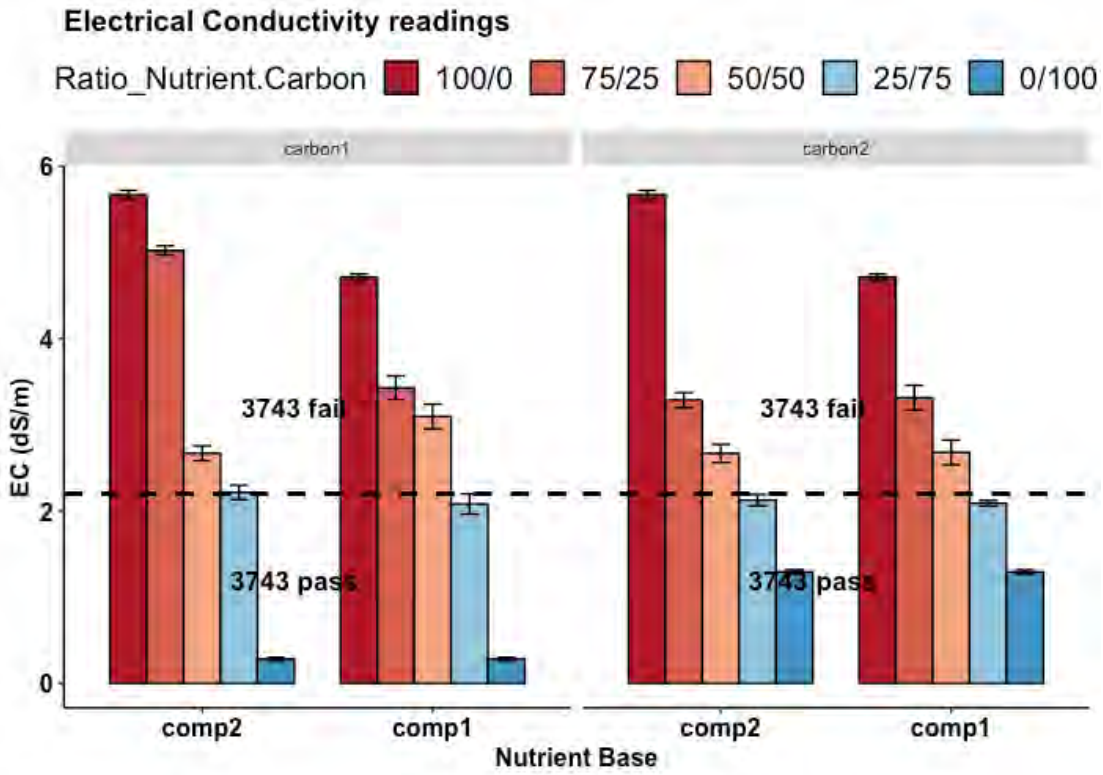


Figure 1. EC comparison between the two nutrient base fractions and two different carbon bases, EC in dS/m, bars are the mean of each treatment and the error bars are the standard error of the mean (n=3).

- The 100% Carbon1 treatment had a significantly lower EC on average (EC = 0.28 dS/m) compared to the others.
- Nutrient base concentrations that were more than 50% did not pass the EC standard (< 2.2 dS/m).
- Those that passed the standard (< 2.2 dS/m) were the 25/75 and 0/100 ratios. This can be seen in both nutrient base fractions and both carbon bases.

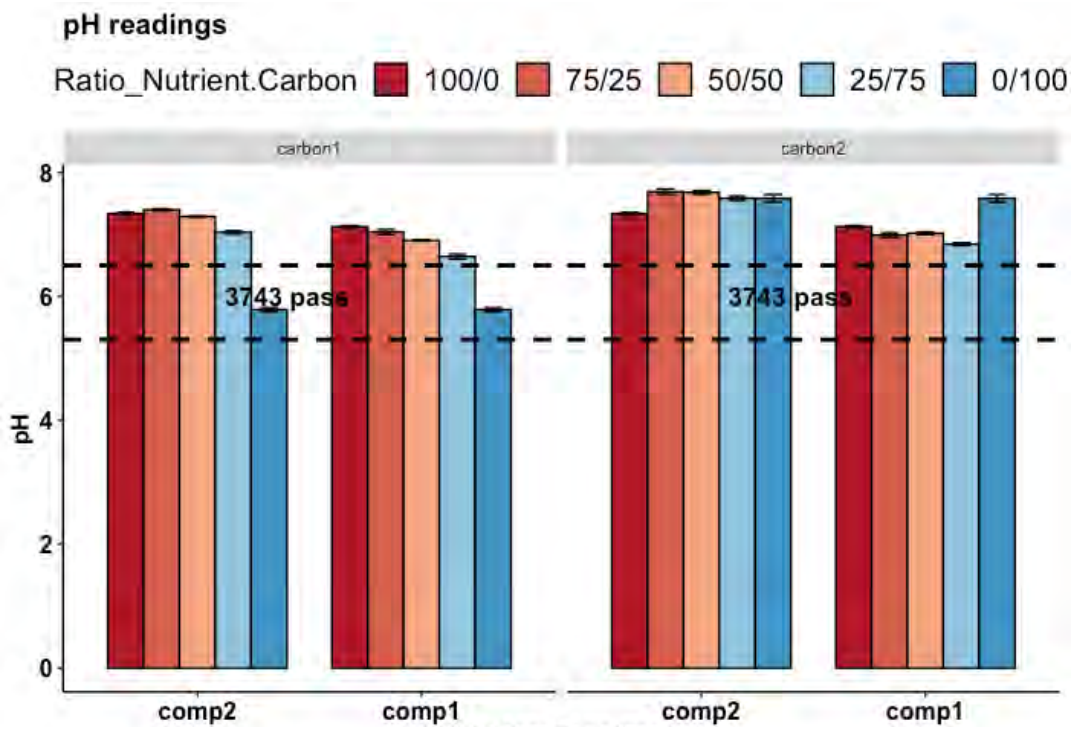


Figure 2. pH comparison between the two compost fractions and two different carbon bases, bars are the mean of each treatment and the error bars are the standard error of the mean (n=3).

- Out of the two carbon bases, only Carbon1 passed the standard (pH = 5.79)
- However, only the 100% Carbon1 treatment was in compliance, as the rest surpassed the standard.
- Comp1 combined with Carbon1 at a 25/75 ratio came close to be compatible with the standard (pH = 6.64).

## PH AND EC COMPARISON OF COMMERCIAL POTTING MIXES

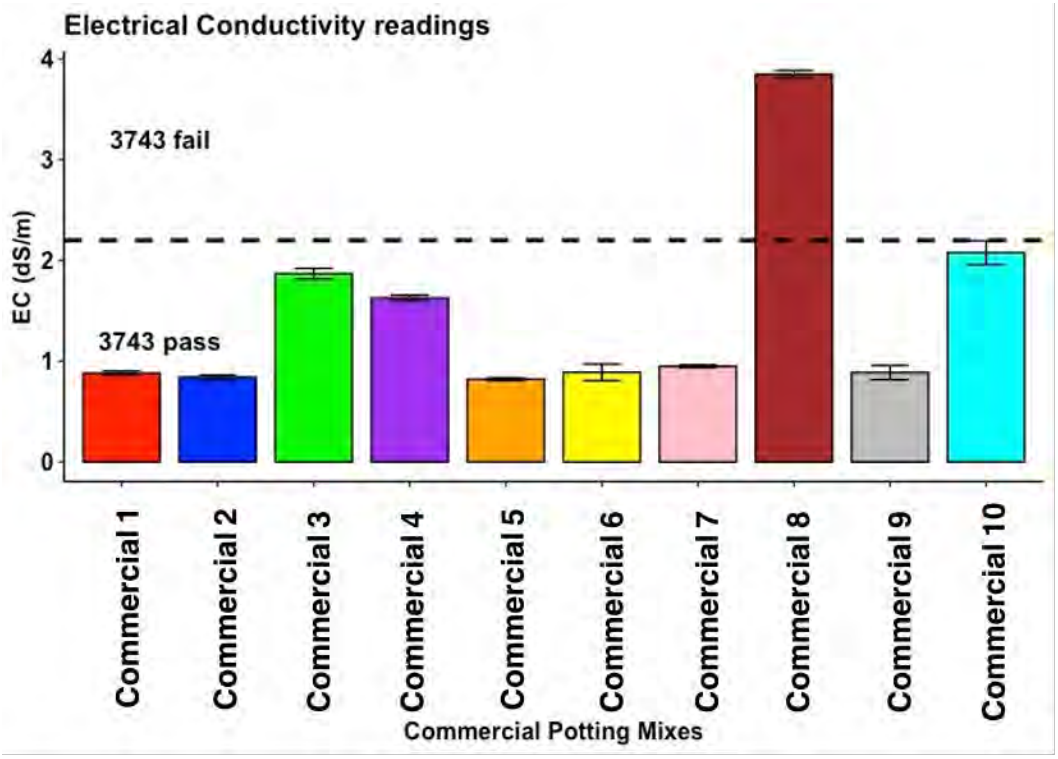


Figure 3. Overview of all MSD treatments, EC in dS/m, bars are the mean of each treatment and the error bars are the standard error of the mean (n=3).

- Seasol Garden Soil Mix showed exceedingly higher EC values than the others.
- It was the only one to not pass the standard (< 2.2 dS/m).

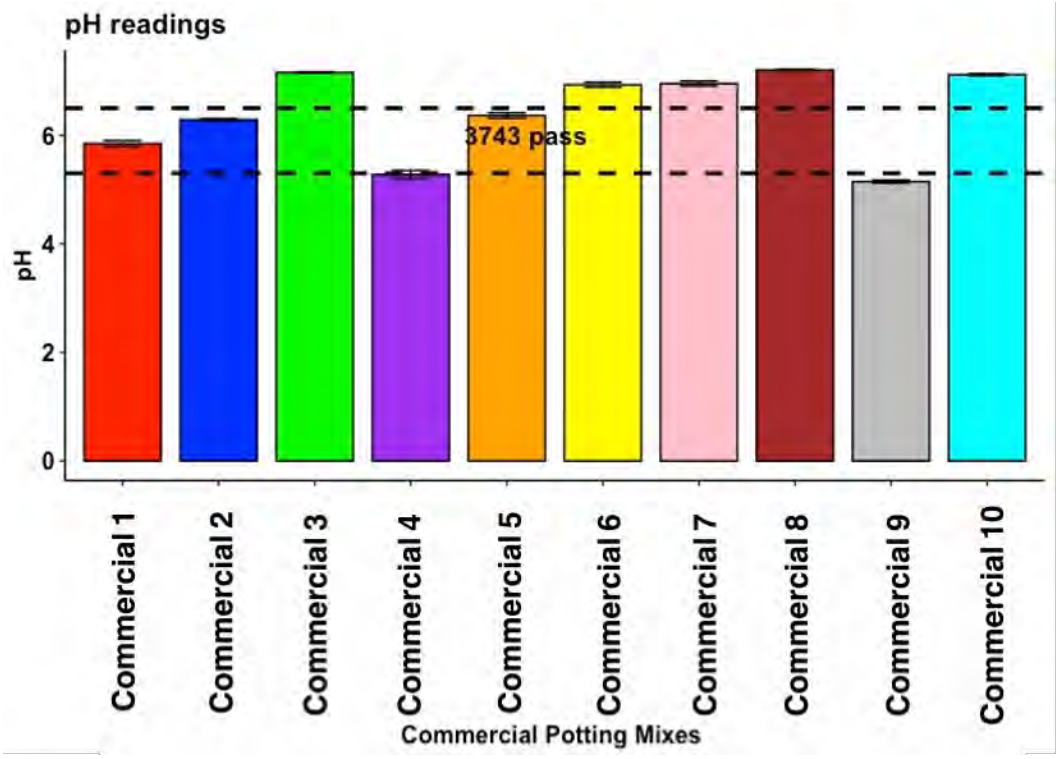


Figure 4. pH overview of all MSD treatments, bars are the mean of each treatment and the error bars are the standard error of the mean (n=3).

- Richgro Black Marvel, Richgro Pro Mix Seaweed, and Garden Basics premium were the only bagged potting mixes that passed the standard for pH (5.3 to 6.5).
- Baileys Premium and Yates Premium were close to be considered compatible with the pH standard.

## DRY SHOOT BIOMASS COMPARISON OF NUTRIENT AND CARBON BASES

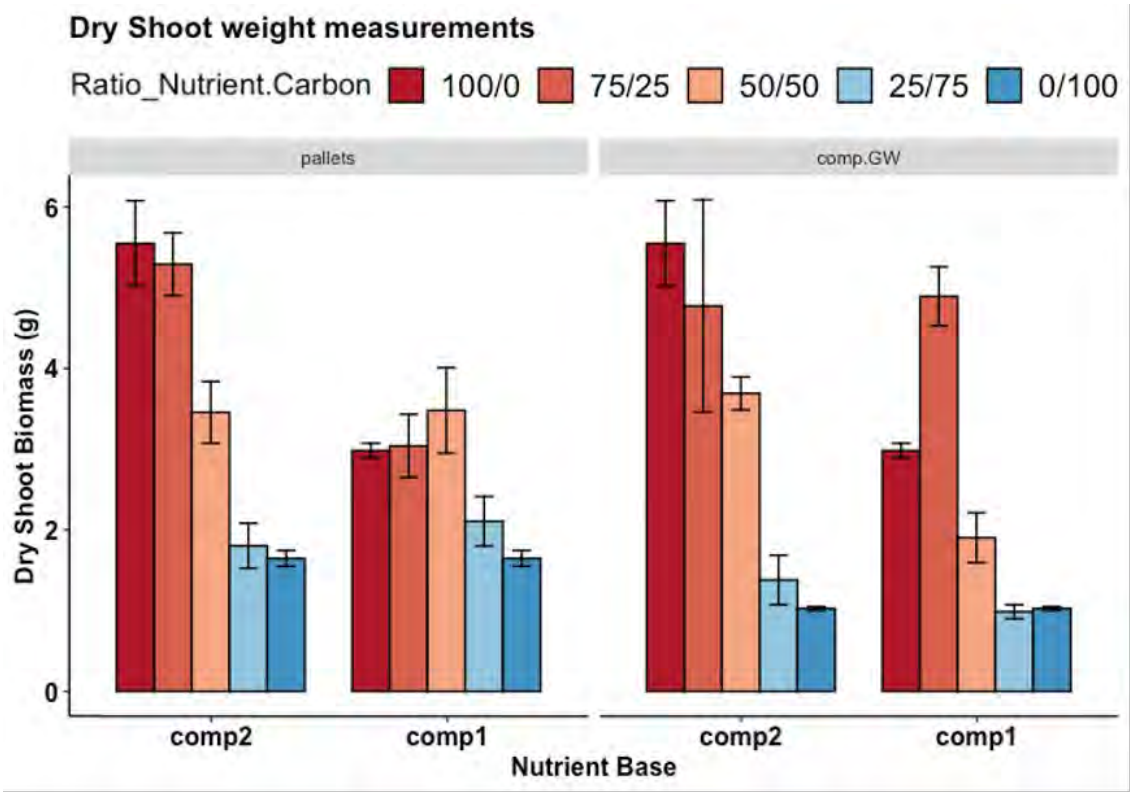


Figure 5. Dry shoot biomass of total petunias per pot in response to different treatments/ Each bar represents the average of three replicates within one treatment (n=3).

- The 100% Comp2 treatment had the highest dry shoot biomass on average (5.55 g).
- The 25/75 ratio for the Comp1 with Carbon2 had the lowest dry shoot biomass on average (0.99 g).
- On average, the top three best-performing treatments on plant growth include the 100/0 ratio for Comp2 (5.55 g), 75/25 ratio for Comp2 with Carbon1 (5.29 g), and 75/25 ratio for Comp1 with Carbon2 (4.89 g).

## DRY SHOOT BIOMASS COMPARISON OF COMMERCIAL POTTING MIXES

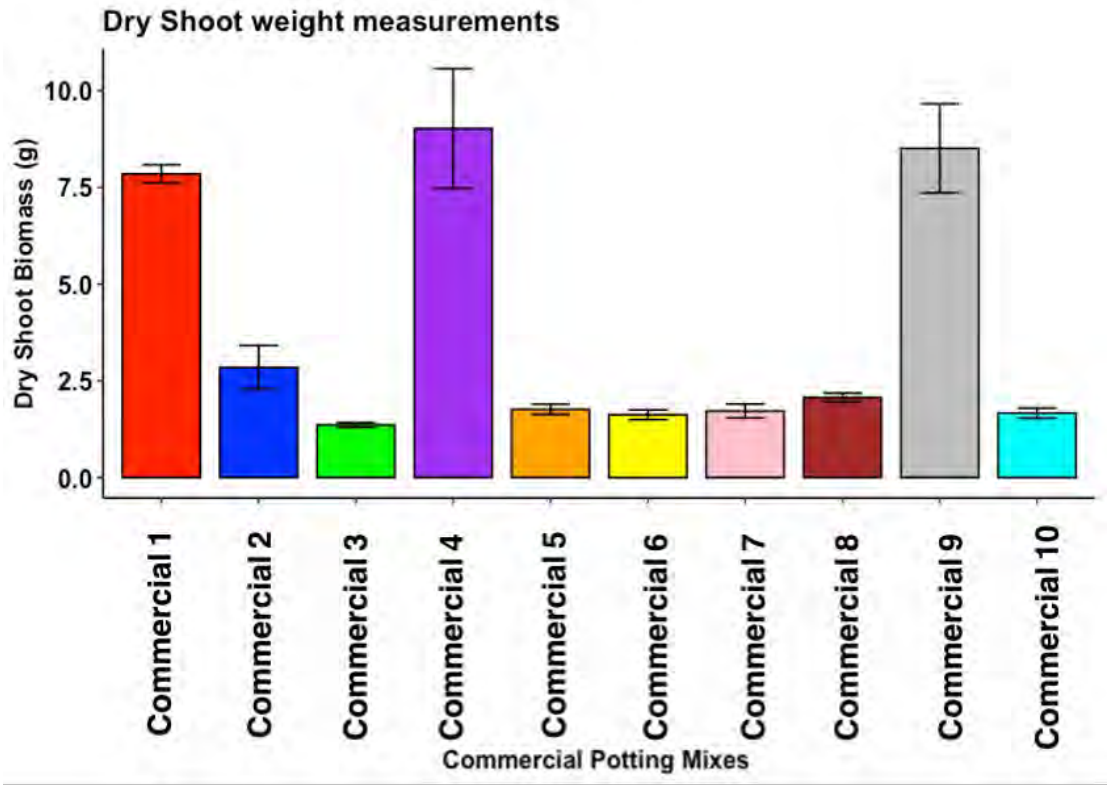


Figure 6. Dry shoot biomass of total petunias per pot in response to different treatments/ Each bar represents the average of three replicates within one treatment (n=3).

- Commercial4 returned the highest biomass on average (9.02 g), with Commercial9 (8.51 g) and Commercial1 (7.85 g) tailing behind.

## CONCLUSIONS

This research project has successfully measured the pH and EC compatibility of different waste streams as potential substitutes for traditional potting media in accordance with the Australian Standard AS-3743-2003.

The results indicate that some combinations of compost fractions and carbon bases, specifically the sawdust pallets, can fulfill the required standards for EC and pH. Notably, the treatment containing 100% Carbon1 presented compliance in both standards without adding any modifications, suggesting its potential as an eligible alternative for sustainable potting media. On the contrary, most treatments, especially those with higher nutrient base concentrations, have failed to meet the standards. This implies that they might need further refinement to reduce the EC levels and adjust the pH values to fall within the acceptable range. However, it was evident in Figure 5 that the 100% Comp2 treatment generated the highest dry shoot biomass, followed by the 75% Comp2 with 25% Carbon1 and 75% Comp1 with 25% Carbon2.

In conclusion, the treatments with 25% and 0% nutrient base concentrations in combination with Carbon1 performed the best in terms of EC and pH measurements, demonstrating overall compatibility to the Australian standards. Nearly all trial treatments had pH levels that were too high overall and may need chemical modifications in order to meet the standards. Among commercial potting mixes, it appeared that Commercial1, Commerical2, and Commercial5 performed the best in terms of their EC and pH compliance to the Australian standards. However, when looking at the biomass results, Commercial4 performed the best. Nevertheless, this study contributes to a foundation for future research and development in obtaining environmentally sustainable potting media that comply with industry standards.

## RECOMMENDATIONS

- Market ready products: 100% Comp1
- Others that come close (e.g., 25% Comp1 and 75% Carbon 1, alongside 25% Comp2 and 75% Carbon1 might need further adjustments to become market ready
- Important to note: 100% Comp2 may be suitable for plant growth due to the high biomass. However, long-term plant growth should be assured by conducting another experiment with a longer timeframe.

## APPENDICES

Appendix A. Petunia flowers grown in Comp1 and Carbon1 mixes in ratios from 100:0 to 0:100 with 25% intervals.

Appendix B. Petunia flowers grown in Comp1 and Carbon2 mixes in ratios from 100:0 to 0:100 with 25% intervals.

Appendix C. Petunia flowers grown in Comp2 and Carbon1 mixes in ratios from 100:0 to 0:100 with 25% intervals.

Appendix C. Petunia flowers grown in Comp2 and Carbon2 mixes in ratios from 100:0 to 0:100 with 25% intervals.

Appendix D. Petunia flowers grown in commercial potting mixes ranked from worst to best-performing.

Appendix E. Petunia flowers grown in commercial potting mixes ranked from worst to best-performing (continued).